CLAIMS

1. An electrokinetic device, comprising:

a pumping conduit having a first end and a second end, and including a porous dielectric material;

a conducting conduit having a first end and a second end, said pumping conduit second end and said conducting conduit first end connecting at a junction; and

an odd number of electrodes in electrical communication with said pumping conduit and said conducting conduit.

2. The electrokinetic device of claim 1, wherein said odd number of electrodes comprises a first electrode at potential *V1* in electrical communication with said pumping conduit first end, a second electrode at potential *V2* in electrical communication with said conduit, and a third electrode at potential *V3* in electrical communication with said conducting conduit second end, and wherein *V1* does not equal *V2*.

3. The electrokinetic device of claim 2, wherein *V3* does not equal *V2*.

4. The electrokinetic device of claim 2, wherein *V1*, *V2*, and *V3* are selected so that (*V2* – *V1*) and (*V3* – *V2*) are oppositely signed.

5. The electrokinetic device of claim 4, wherein *V1* is equal to *V3*.

6. The electrokinetic device of claim 5, wherein said potentials *V1* and *V3* are ground potentials.

7. The electrokinetic device of claim 1, wherein said conducting conduit includes a porous material.

8. The electrokinetic device of claim 1, wherein said conducting conduit hydrodynamic conductance, k_c, is greater than said pumping conduit hydrodynamic conductance, k_p.

9. The electrokinetic device of claim 8, wherein $k_c/k_p \geq 2$.

10. The electrokinetic device of claim 9, wherein $k_c/k_p \geq 10$.

11. The electrokinetic device of claim 10, wherein $k_c/k_p \geq 100$.

12. The electrokinetic device of claim 11, wherein $k_c/k_p \geq 1000$.

13. The electrokinetic device of claim 12, wherein $k_c/k_p \geq 10{,}000$.

14. The electrokinetic device of claim 1, wherein said conducting conduit electrokinetic pressure value, $p^{ek}{}_c$, is less than said pumping conduit electrokinetic pressure value, $p^{ek}{}_p$.

15. The electrokinetic device of claim 14, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.5$.

16. The electrokinetic device of claim 15, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.1$.

17. The electrokinetic device of claim 16, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.01$.

18. The electrokinetic device of claim 17, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.001$.

19. The electrokinetic device of claim 18, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.0001$.

20. The electrokinetic device of claim 1, wherein said conducting conduit electrical resistance, R_c, is greater than or equal to said pumping conduit electrical resistance, R_p.

21. The electrokinetic device of claim 20, wherein $R_c/R_p \geq 2$.

22. The electrokinetic device of claim 21, wherein $R_c/R_p \geq 5$.

23. The electrokinetic device of claim 22, wherein $R_c/R_p \geq 10$.

24. The electrokinetic device of claim 23, wherein $R_c/R_p \geq 100$.

25. The electrokinetic device of claim 1, wherein said device is capable of generating 0.1 psi/volt applied across said pumping conduit.

26. The electrokinetic device of claim 25, wherein said device is capable of generating 1 psi/volt applied across said pumping conduit.

27. The electrokinetic device of claim 26, wherein said device is capable of generating 10 psi/volt applied across said pumping conduit.

28. An electrokinetic device, comprising:

a first pumping conduit having a first end and a second end, and including a first porous dielectric material;

a first conducting conduit having a first end and a second end, said first pumping conduit second end and said first conducting conduit first end connecting at a first junction;

a second pumping conduit having a first end and a second end, and including a second porous dielectric material, said first conducting conduit second end and said second pumping conduit first end connecting at a second junction; and

a first electrode in electrical communication with said first pumping conduit first end, a second electrode in electrical communication with said first junction, a third electrode in electrical communication with said second junction, and a fourth electrode in electrical communication with said second pumping conduit second end,

wherein said conducting conduit electrokinetic pressure value, $p^{ek}{}_c$, is less than or equal to the electrokinetic pressure value, $p^{ek}{}_p$, of at least one of said pumping conduits.

29. The electrokinetic device of claim 28 wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.5$.

30. The electrokinetic device of claim 29, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.1$.

31. The electrokinetic device of claim 30, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.01$.

32. The electrokinetic device of claim 31, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.001$.

33. The electrokinetic device of claim 32, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.0001$.

34. The electrokinetic device of claim 28, wherein said conducting conduit hydrodynamic conductance, k_c, is greater than or equal to the hydrodynamic conductance, k_p, of at least one of said pumping conduits.

35. The electrokinetic device of claim 34, wherein $k_c/k_p \geq 2$.

36. The electrokinetic device of claim 35, wherein $k_c/k_p \geq 10$.

37. The electrokinetic device of claim 36, wherein $k_c/k_p \geq 100$.

38. The electrokinetic device of claim 37, wherein $k_c/k_p \geq 1000$.

39. The electrokinetic device of claim 38, wherein $k_c/k_p \geq 10{,}000$.

40. The electrokinetic device of claim 28, wherein said conducting conduit electrical resistance, R_c, is greater than or equal to the electrical resistance, R_p, of at least one of said pumping conduits.

41. The electrokinetic device of claim 40, wherein $R_c/R_p \geq 2$.

42. The electrokinetic device of claim 41, wherein $R_c/R_p \geq 5$.

43. The electrokinetic device of claim 42, wherein $R_c/R_p \geq 10$.

44. The electrokinetic device of claim 43, wherein $R_c/R_p \geq 100$.

45. The electrokinetic device of claim 28, wherein at least one of said conduits is a microscale conduit.

46. The electrokinetic device of claim 28, wherein said first electrode is at potential *V1*, said second electrode is at potential *V2*, said third electrode is at potential *V3*, and said fourth electrode is at potential *V4*, and wherein at least one of the differences (*V1* – *V2*) and (*V3* – *V4*) is not equal to zero.

47. The electrokinetic device of claim 46, wherein *V1*, *V2*, and *V3* are selected so that (*V2* – *V1*) and (*V3* – *V2*) are oppositely signed.

48. The electrokinetic device of claim 46, wherein *V1*, *V2*, *V3*, and *V4* are selected so that (*V2* – *V1*) and (*V4* – *V3*) are oppositely signed.

49. The electrokinetic device of claim 46, wherein *V1*, *V2*, *V3*, and *V4* are selected so that (*V2* – *V1*) and (*V4* – *V3*) are same signed.

50. The electrokinetic device of claim 46, wherein *V1* is equal to *V4*.

51. The electrokinetic device of claim 50, wherein said potentials *V1* and *V4* are ground potentials.

52. The electrokinetic device of claim 28, wherein said first porous dielectric material is the same as said second porous dielectric material.

53. The electrokinetic device of claim 28, wherein said first porous dielectric material is different from said second porous dielectric material.

54. The electrokinetic device of claim 53, wherein said first and said second porous dielectric materials have oppositely-signed zeta potentials when contacted with a pumping fluid.

55. The electrokinetic device of claim 28, wherein said conducting conduit includes a porous material.

56. The electrokinetic device of claim 28, wherein said device is capable of generating an electroosmotic force on an aqueous fluid.

57. The electrokinetic device of claim 28, wherein said device is capable of generating an electroosmotic force on a fluid mixture comprising an aqueous component and an organic component.

58. The electrokinetic device of claim 28, wherein said device is capable of generating 0.05 psi/volt applied across said first and said second pumping conduits.

59. The electrokinetic device of claim 58, wherein said device is capable of generating 2 psi/volt applied across said first and said second pumping conduits.

60. An electrokinetic device, comprising:

a first pumping conduit having a first end and a second end, and including a first porous dielectric material;

a first conducting conduit having a first end and a second end, said first pumping conduit second end and said first conducting conduit first end connecting at a first junction;

a second pumping conduit having a first end and a second end, and including a second porous dielectric material, said second pumping conduit first end connecting to said first conducting conduit second end at a second junction;

a second conducting conduit having a first end and a second end, said second pumping conduit second end connecting to said second conducting conduit first end at a third junction; and

an odd number of electrodes in electrical communication with said pumping conduits and said conducting conduits.

61. The electrokinetic device of claim 60, wherein said odd number of electrodes comprises a first electrode at potential *V1* in electrical communication with

said first pumping conduit first end, a second electrode at potential *V2* in electrical communication with said first junction, a third electrode at potential *V3* in electrical communication with said second junction, a fourth electrode at potential *V4* at said third junction, and a fifth electrode at potential *V5* at said second conducting conduit second end, and wherein at least one of the differences (*V1* – *V2*) and (*V3* – *V4*) does not equal zero.

62. The electrokinetic device of claim 61, wherein *V2* does not equal *V3*.

63. The electrokinetic device of claim 61, wherein *V4* does not equal *V5*.

64. The electrokinetic device of claim 61, wherein *V1*, *V2*, *V4*, and *V5* are selected so that (*V2* – *V1*) and (*V5* – *V4*) are oppositely signed.

65. The electrokinetic device of claim 61, wherein *V1* is equal to *V5*.

66. The electrokinetic device of claim 65, wherein said potentials *V1* and *V5* are ground potentials.

67. The electrokinetic device of claim 60, wherein any of said conducting conduits includes a porous material.

68. The electrokinetic device of claim 60, wherein said device is capable of generating an electroosmotic force on an aqueous fluid.

69. The electrokinetic device of claim 60, wherein said device is capable of generating an electroosmotic force on a fluid mixture comprising an aqueous component and an organic component.

70. The electrokinetic device of claim 60, wherein said device is capable of generating 0.05 psi/volt applied across said first and said second pumping conduits.

71. The electrokinetic device of claim 60, wherein said device is capable of generating 2 psi/volt applied across said first and said second pumping conduits.

72. The electrokinetic device of claim 60, wherein the hydrodynamic conductance, k_c, of at least one of said conducting conduits is greater than the hydrodynamic conductance, k_p, of at least one of said pumping conduits.

73. The electrokinetic device of claim 72, wherein $k_c/k_p \geq 2$.

74. The electrokinetic device of claim 73, wherein $k_c/k_p \geq 10$.

75. The electrokinetic device of claim 74, wherein $k_c/k_p \geq 100$.

76. The electrokinetic device of claim 75, wherein $k_c/k_p \geq 1000$.

77. The electrokinetic device of claim 76, wherein $k_c/k_p \geq 10{,}000$.

78. The electrokinetic device of claim 60, wherein the electrokinetic pressure value, $p^{ek}{}_c$, of at least one of said conducting conduits is less than the electrokinetic pressure value, $p^{ek}{}_p$, of at least one of said pumping conduits.

79. The electrokinetic device of claim 78, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.5$.

80. The electrokinetic device of claim 79, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.1$.

81. The electrokinetic device of claim 80, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.01$.

82. The electrokinetic device of claim 81, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.001$.

83. The electrokinetic device of claim 82, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.0001$.

84. The electrokinetic device of claim 60, wherein the electrical resistance, R_c, of at least one of said conducting conduits is greater than or equal to the electrical resistance, R_p, of at least one of said pumping conduits.

85. The electrokinetic device of claim 84, wherein $R_c/R_p \geq 2$.

86. The electrokinetic device of claim 85, wherein $R_c/R_p \geq 5$.

87. The electrokinetic device of claim 86, wherein $R_c/R_p \geq 10$.

88. The electrokinetic device of claim 87, wherein $R_c/R_p \geq 100$.

89. The electrokinetic device of claim 60, wherein said odd number of electrodes comprises a first electrode at potential *V1* in electrical communication with said first pumping conduit first end, and an N^{th} electrode at potential *VN* in electrical communication with a second end of a terminal conducting conduit.

90. The electrokinetic device of claim 89, wherein *V1* is equal to *VN*.

91. The electrokinetic device of claim 90, wherein said potentials *V1* and *VN* are ground potentials.

92. A method of controlling the flow of a fluid, comprising:

contacting said pumping conduit first end of the electrokinetic device of claim 1 with a fluid; and

supplying potential *V1* to a first electrode in electrical communication with said pumping conduit first end, potential *V2* to a second electrode in electrical communication with said junction, and potential *V3* to a third electrode in electrical communication with said conducting conduit second end.

93. The method of claim 92, wherein *V1* does not equal *V2*.

94. The method of claim 92, wherein *V3* does not equal *V2*.

95. The method of claim 92, wherein *V1*, *V2*, and *V3* are selected so that (*V2* – *V1*) and (*V3* – *V2*) are oppositely signed.

96. The method of claim 92, wherein *V1* is equal to *V3*.

97. The method of claim 96, wherein said potentials *V1* and *V3* are ground potentials.

98. The method of claim 92, further comprising supplying a pressure-driven flow to said pumping conduit, and modulating said pressure-driven flow by an electroosmotically-driven flow component generated within said pumping conduit.

99. A method of controlling the flow of a fluid, comprising:

contacting at least one end of said first pumping conduit or said second pumping conduit of the electrokinetic device of claim 28 with a fluid; and

supplying potential *V1* to a first electrode in electrical communication with said first pumping conduit first end, potential *V2* to a second electrode in electrical communication with said first junction, potential *V3* to a third electrode in electrical communication with said second junction, and potential *V4* to a fourth electrode in electrical communication with said second pumping conduit second end.

100. The method of claim 99, wherein at least one of said differences (*V1* – *V2*) and (*V3* – *V4*) is not equal to zero.

101. The method of claim 99, wherein at least one of said differences (*V1* – *V2*) and (*V3* – *V4*) is less than 200 volts.

102. The method of claim 99, wherein *V1*, *V2*, and *V3* are selected so that (*V2* – *V1*) and (*V3* – *V2*) are oppositely signed.

103. The method of claim 99, wherein *V1*, *V2*, *V3*, and *V4* are selected so that (*V2* – *V1*) and (*V4* – *V3*) are oppositely signed.

104. The method of claim 99, wherein *V1*, *V2*, *V3*, and *V4* are selected so that (*V2* – *V1*) and (*V4* – *V3*) are same signed.

105. The method of claim 99, wherein *V1* is equal to *V4*.

106. The method of claim 105, wherein said potentials *V1* and *V4* are ground potentials.

107. The method of claim 99, further comprising supplying a pressure-driven flow to said device, and modulating said pressure-driven flow by an electroosmotically-driven flow component generated within said first or said second pumping conduit.

108. A method of controlling the flow of a fluid, comprising:

contacting at least one end of said first pumping conduit or said second pumping conduit of the electrokinetic device of claim 60 with a fluid; and

supplying potential *V1* to a first electrode in electrical communication with said first pumping conduit first end, potential *V2* to a second electrode in electrical communication with said first junction, potential *V3* to a third electrode in electrical communication with said second junction, potential *V4* to a fourth electrode in electrical communication with said third junction, and potential *V5* to said second conducting conduit second end.

109. The method of claim 108, wherein at least one of the differences (*V1* – *V2*) and (*V3* – *V4*) is not equal to zero.

110. The method of claim 108, wherein *V2* does not equal *V3*.

111. The method of claim 108, wherein *V4* does not equal *V5*.

112. The method of claim 108, wherein *V1*, *V2*, *V4*, and *V5* are selected so that (*V2* – *V1*) and (*V5* – *V4*) are oppositely signed.

113. The method of claim 108, wherein *V1* is equal to *V5*.

114. The method of claim 113, wherein said potentials *V1* and *V5* are ground potentials.

115. The method of claim 108, further comprising supplying a pressure-driven flow to said device, and modulating said pressure-driven flow by an electroosmotically-driven flow component generated within said first or said second pumping conduit.

116. An electrokinetic device, comprising:

a pumping conduit having a first end and a second end, and including a porous dielectric material;

a conducting conduit having a first end and a second end, said pumping conduit second end and said conducting conduit first end connecting at a junction; and

a first electrode at potential *V1* in electrical communication with said pumping conduit first end, a second electrode at potential *V2* in electrical communication with said junction, and a third electrode at potential *V3* in electrical communication with said conducting conduit second end, wherein a predetermined electroosmotic flow may be generated by said device with at least one of said potentials *V1* and *V3* assuming an arbitrary value.

117. The electrokinetic device of claim 116, wherein *V1* does not equal *V2*.

118. The electrokinetic device of claim 116, wherein *V3* does not equal *V2*.

119. The electrokinetic device of claim 116, wherein *V1*, *V2*, and *V3* are selected so that (*V2* – *V1*) and (*V3* – *V2*) are oppositely signed.

120. The electrokinetic device of claim 116, wherein *V1* is equal to *V3*.

121. The electrokinetic device of claim 120, wherein said potentials *V1* and *V3* are ground potentials.

122. The electrokinetic device of claim 116, wherein said conducting conduit includes a porous material.

123. The electrokinetic device of claim 116, wherein said conducting conduit hydrodynamic conductance, k_c, is greater than said pumping conduit hydrodynamic conductance, k_p.

124. The electrokinetic device of claim 123, wherein $k_c/k_p \geq 2$.

125. The electrokinetic device of claim 124, wherein $k_c/k_p \geq 10$.

126. The electrokinetic device of claim 125, wherein $k_c/k_p \geq 100$.

127. The electrokinetic device of claim 126, wherein $k_c/k_p \geq 1000$.

128. The electrokinetic device of claim 127, wherein $k_c/k_p \geq 10{,}000$.

129. The electrokinetic device of claim 116, wherein said conducting conduit electrokinetic pressure value, $p^{ek}{}_c$, is less than said pumping conduit electrokinetic pressure value, $p^{ek}{}_p$.

130. The electrokinetic device of claim 129, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.5$.

131. The electrokinetic device of claim 130, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.1$.

132. The electrokinetic device of claim 131, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.01$.

133. The electrokinetic device of claim 132, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.001$.

134. The electrokinetic device of claim 133, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.0001$.

135. The electrokinetic device of claim 116, wherein said conducting conduit electrical resistance, R_c, is greater than or equal to said pumping conduit electrical resistance, R_p.

136. The electrokinetic device of claim 135, wherein $R_c/R_p \geq 2$.

137. The electrokinetic device of claim 136, wherein $R_c/R_p \geq 5$.

138. The electrokinetic device of claim 137, wherein $R_c/R_p \geq 10$.

139. The electrokinetic device of claim 138, wherein $R_c/R_p \geq 100$.

140. The electrokinetic device of claim 116, wherein said device is capable of generating 0.05 psi/volt applied across said pumping conduit.

141. The electrokinetic device of claim 140, wherein said device is capable of generating 0.1 psi/volt applied across said pumping conduit.

142. The electrokinetic device of claim 141, wherein said device is capable of generating 1 psi/volt applied across said pumping conduit.

143. The electrokinetic device of claim 142, wherein said device is capable of generating 10 psi/volt applied across said pumping conduit.

144. An electrokinetic device, comprising:

a first pumping conduit having a first end and a second end, and including a first porous dielectric material;

a first conducting conduit having a first end and a second end, said first pumping conduit second end and said first conducting conduit first end connecting at a first junction;

a second pumping conduit having a first end and a second end, and including a second porous dielectric material, said second pumping conduit first end connecting to said first conducting conduit second end at a second junction;

a second conducting conduit having a first end and a second end, said second pumping conduit second end connecting to said second conducting conduit first end at a third junction; and

a first electrode at potential *V1* in electrical communication with said first pumping conduit first end, a second electrode at potential *V2* in electrical communication with said first junction, a third electrode at potential *V3* in electrical communication with said second junction, a fourth electrode at potential *V4* in electrical communication with said third junction, and a fifth electrode at potential *V5* in electrical communication with said second conducting channel second end, wherein a predetermined electroosmotic flow may be generated by said device with at least one of said potentials *V1* and *V5* assuming an arbitrary value.

145. The device of claim 144, wherein at least one of the differences (*V1* – *V2*) and (*V3* – *V4*) does not equal zero.

146. The electrokinetic device of claim 144, wherein *V2* does not equal *V3*.

147. The electrokinetic device of claim 144, wherein *V4* does not equal *V5*.

148. The electrokinetic device of claim 144, wherein *V1*, *V2*, *V4*, and *V5* are selected so that (*V2* – *V1*) and (*V5* – *V4*) are oppositely signed.

149. The electrokinetic device of claim 144, wherein *V1* is equal to *V5*.

150. The electrokinetic device of claim 149, wherein said potentials *V1* and *V5* are ground potentials.

151. The electrokinetic device of claim 144, wherein any of said conducting conduits includes a porous material.

152. The electrokinetic device of claim 144, wherein said device is capable of generating 0.05 psi/volt applied across said first and said second pumping conduits.

153. The electrokinetic device of claim 152, wherein said device is capable of generating 2 psi/volt applied across said first and said second pumping conduits.

154. The electrokinetic device of claim 144, wherein the hydrodynamic conductance, k_c, of at least one of said conducting conduits is greater than the hydrodynamic conductance, k_p, of at least one of said pumping conduits.

155. The electrokinetic device of claim 154, wherein $k_c/k_p \geq 2$.

156. The electrokinetic device of claim 155, wherein $k_c/k_p \geq 10$.

157. The electrokinetic device of claim 156, wherein $k_c/k_p \geq 100$.

158. The electrokinetic device of claim 157, wherein $k_c/k_p \geq 1000$.

159. The electrokinetic device of claim 158, wherein $k_c/k_p \geq 10{,}000$.

160. The electrokinetic device of claim 144, wherein the electrokinetic pressure value, $p^{ek}{}_c$, of at least one of said conducting conduits is less than the electrokinetic pressure value, $p^{ek}{}_p$, of at least one of said pumping conduits.

161. The electrokinetic device of claim 160, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.5$.

162. The electrokinetic device of claim 161, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.1$.

163. The electrokinetic device of claim 162, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.01$.

164. The electrokinetic device of claim 163, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.001$.

165. The electrokinetic device of claim 164, wherein $p^{ek}{}_c/p^{ek}{}_p \leq 0.0001$.

166. The electrokinetic device of claim 144, wherein the electrical resistance, R_c, of at least one of said conducting conduits is greater than or equal to the electrical resistance, R_p, of at least one of said pumping conduits.

167. The electrokinetic device of claim 166, wherein $R_c/R_p \geq 2$.

168. The electrokinetic device of claim 167, wherein $R_c/R_p \geq 5$.

169. The electrokinetic device of claim 168, wherein $R_c/R_p \geq 10$.

170. The electrokinetic device of claim 169, wherein $R_c/R_p \geq 100$.